

CALYPTOGENA (CALYPTOGENA) BIRMANI, A NEW SPECIES OF
VESICOMYIDAE (MOLLUSCA-BIVALVIA) FROM BRAZIL

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ABSTRACT

Calyptogena (Calyptogena) birmani, a new species of a rare deep-sea family, Vesicomylidae, is described from material collected at a depth of 400 m off the State of Paraná, southwest Atlantic Ocean, Brazilian coast, by the R/V W. BESNARD. No living specimens were obtained, and only the shell characters were compared with the known *Calyptogena* species from the Atlantic and with the most closely related species from the Pacific.

Key words: bivalve, Vesicomylidae, *Calyptogena*, systematics, Brazil.

INTRODUCTION

During the 2–4 October 1978, the R/V W. BESNARD, of the Instituto Oceanográfico, Universidade de São Paulo, collected off the coast of São Paulo and Paraná states, Brazil, in the southwest Atlantic Ocean, a number of shallow to deep-water samples, using a Campbell Photo-Grab. At station 2 in a depth of 400 m, 14 empty shells (entire specimens with both valves), 87 left valves and 93 right valves were obtained of an unusually small veneroid-shaped bivalve. Based on careful examination and comparison of this material with the published literature, the specimens were found to be a new species referable to Vesicomylidae Dall & Simpson, 1901. The Vesicomylidae were not known from Brazil until 1975 (Lange de Morretes, 1949, 1954; Rios, 1970, 1975). In a preliminary study, Birman & Lopes (1985) suggested that the R/V W. BESNARD material belonged to *Calyptogena* Dall, 1891, and considered it the first occurrence of the Vesicomylidae along the Brazilian coast. On this basis, Rios (1985) updated his catalogue. A more accurate review of the papers related to Vesicomylidae revealed that Dall (1889) had already described *Callocardia albida* from off Rio de Janeiro, at a depth of 108 m, and had placed it in the Isocardiidae; later, Keen (1969) allocated it to the Vesicomylidae.

The taxa grouped under Vesicomylidae have had a confused history as discussed by Boss (1968, 1969, 1970), Boss & Turner (1980) and Turner (1985). The lack of a sat-

isfactory diagnosis that would exclude them from all other related heterodonts has led various authors to assign these taxa to such families as the Arcticidae (= Cyprinidae), Carditidae, Kelliellidae and Veneridae (Boss & Turner, 1980). It is beyond the scope of this paper to discuss the systematics of the group. Most authors, following Keen (1969) and Boss & Turner (1980), have considered *Calyptogena* to belong to the Vesicomylidae.

Vesicomylidae is a rare deep-sea family whose living species examined to date come from sulfide-rich substrates (Turner, 1985).

The discovery of deep-sea hydrothermal vents on the eastern Pacific sea floor and deep sulfide seeps in the Gulf of Mexico has attracted the attention of zoologists to their abundant macrofauna of which Vesicomylidae was found to be one of the major components (Turner, 1985). Besides bacterial chemosynthetic activity, which provides the major bulk of the food supply for the vent and seep communities (Turner & Lutz, 1984), a symbiotic association of these bacteria with clams, mussels, tube worms, plays an important role in their nutrition and distribution (Cavanaugh, 1983), and in the food chain dynamics at the vents and seeps (Turner & Lutz, 1984). Vesicomylidae are also known from reducing sediments not related to vents or seeps, as is the case of *Calyptogena (Ectenagena) australis* Stuardo & Valdovinos, 1988, from off the coast of central Chile (Stuardo & Valdovinos, 1988).

All living species of Vesicomylidae known to date shelter chemoautotrophic symbiotic bac-

teria in their large and thick gills (Turner, 1985; Stuardo & Valdovinos, 1988). Based on this fact and on shell characters, Turner (1985) suggested the origin of the large species of Vesicomidae, found at the vents and seeps, from small, infaunal deep-sea kelliellid bivalves, by adopting the habit of harbouring symbiotic bacteria in the gills. On the other hand, Stuardo & Valdovinos (1988) speculated that vesicomids might have developed endosymbiosis as an adaptation to reducing sediments, becoming preadapted to invade the specialized habitat of the hydrothermal vents. The requirement of such a special environment makes the Vesicomidae good indicators of sulfide-rich sediments and/or vents or seeps.

The deep sea of the southern Atlantic is scarcely explored for these habitats, and the discovery of a new vesicomid from off the coast of Paraná (25°40'5''S; 44°59'0''W) contributes to the knowledge of the Vesicomidae distribution and opens new perspectives to carry on important research projects that may lead to the discovery of similar sulfide-rich or reducing habitats and associated communities in southern latitudes.

Calyptogena (Calyptogena) birmani,
Domaneschi & Lopes, sp. n.
Figs. 1–14

Holotype: Museu de Zoologia, Universidade de São Paulo (MZUSP) 26691 (Figs. 1–4, 5, 8).

Measurements: length: 12.7 mm; height: 8.3 mm; width: 5.2 mm.

Paratypes: Museu de Zoologia, Universidade de São Paulo 26692 to 26699 (complete shells), 26700 to 26705 (odd valves); Departamento de Zoologia, Instituto de Biociências, Universidade de São Paulo (DZ-IBUSP), without registration numbers, only odd valves (80 right, 74 left); Academy of Natural Sciences of Philadelphia (ANSP) (two complete shells and ten odd valves: five right, five left); United States Natural Museum (USNM) (two complete shells and ten odd valves: five right, five left).

Type-locality: R/V W. BESNARD station 2, 25°40'5''S; 44°59'0''W, off the Paraná coast, Brazil, at a depth of 400 m; sand-clay bottom sediment containing 39.92% calcareous and 1.76% organic matter; water temperature and salinity 2 m above bottom surface respectively 15.15°C and 35.55‰.

Description: Shell to 21.6 mm in length and 15.3 mm in height (largest known specimen—Fig. 14), subtrigonal to elongate ovate (Figs. 11–13), inequilateral, equivalve, rather solid, moderately inflated, with both valves of equal convexity, not gaping (Fig. 1–4). Umbones anterior (1/3 of shell length behind anterior end), small, pointed, weakly involute, prosocline; umbonal cavity shallow. Anterior margin rather short, convex and uniformly rounded; ventral margin smooth, moderately to broadly convex and rising gently posteriorly; posterior margin at the lower half of the shell height, short and narrowly rounded, forming pointed angular outline; anterodorsal margin short, slightly convex and gently descending, with a weak concavity near the umbones; postero-dorsal margin long, convex to nearly straight, moderately to rather steeply descending. Concentric sculpture consisting of growth lines and weak lirations, best preserved on the anterior and posterior slopes; radial sculpture lacking. Radial posterior ridges proceeding from the umbones form the posterior dorsal margin and border a lanceolate, long and deep escutcheon, steeper walled near the umbones. Ligament opisthodontic, light brown, elongate (2/3 of escutcheon length), deeply inset and subtended by thickened, elongate and somewhat protuberant nymphal callosities (ligament lost in most specimens examined or with the periostracal portion present, sometimes associated with residues of the calcareous portion). No lunule; lunular area circumscribed by weakly elevated lines. Left valve with moderately thickened, elongated, shelf-like posterodorsal cardinal tooth and subumbonal cardinal tooth consisting of two portions, the anterior longer, shelf-like and the posterior massive, protuberant; excavated U-shaped socket between them (Figs. 5–7). Right valve with dorsal arched cardinal tooth consisting of a narrow, shelf-like anterior extension which advances forward a short distance from the umbo and a broad, thickened posterior portion; ventral cardinal tooth somewhat pointed, elongated, arcuate and extending anteriorly; posterior cardinal tooth lacking (Figs. 8–10, 14). True internal radial rib lacking, but rib-like thickening radiating posteriorly, often present inside umbonal cavity. Anterior adductor muscle scar dorsoventrally elongate, ovate, strongly impressed especially on the posterior margin; posterior adductor muscle scar irregularly rounded, but more weakly impressed. Anterior pedal retractor scar deeply impressed, slightly sepa-

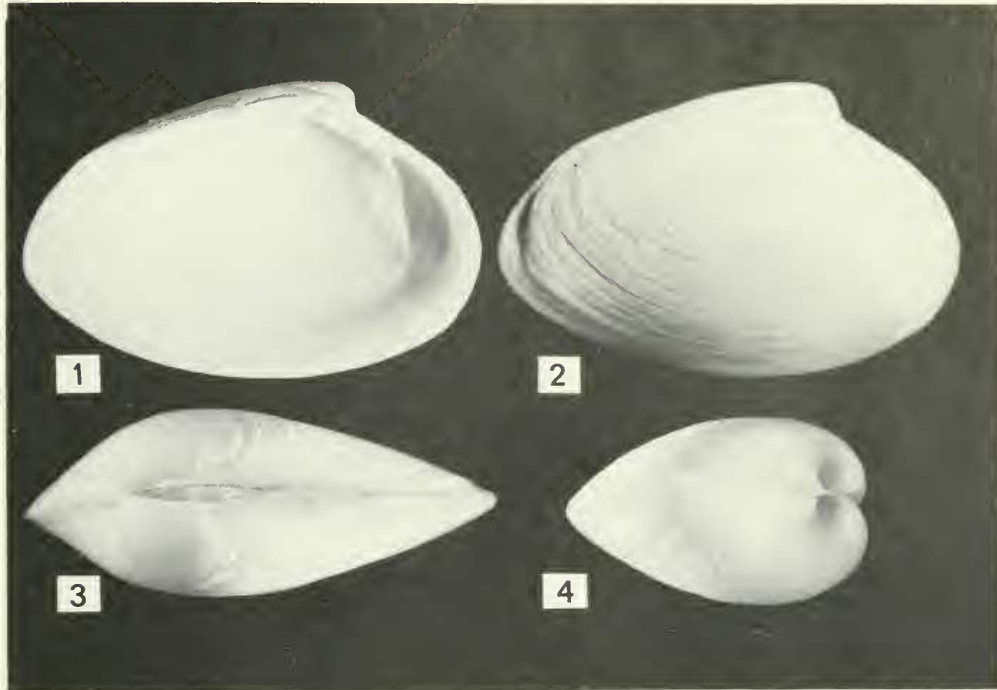


FIG. 1-4. The holotype of *Calyptogena birmani*, MZUSP 26691 (length = 12.7 mm): 1, internal view of the left valve showing muscle scars; 2, external view of the right valve; 3, dorsal view of complete specimen showing ligamental area, escutcheon; 4, anterodorsal view of complete specimen to show faintly circumscribed lunular area.

rated from the dorsal end of adductor scar; posterior pedal retractor scar fused with the adductor. Pallial line smooth and convex; pallial sinus extremely shallow, broad and rounded (Figs. 11-13). Shell chalky, dirty white, shining; interior white with a central russet stain. Inner margin of the valves incised by parallel oblique lines.

Measurements (mm) (material deposited in the MZUSP):

Specimens with both valves

length	height	width	
20.7	12.8	8.7	Paratype (MZUSP 26692)
19.3	13.9	9.9	Paratype (MZUSP 26693)
15.7	10.6	7.1	Paratype (MZUSP 26694)
15.4	9.7	6.2	Paratype (MZUSP 26695)
14.8	11.4	7.7	Paratype (MZUSP 26696)
14.1	8.6	5.6	Paratype (MZUSP 26697)
12.8	8.3	5.2	Paratype (MZUSP 26698)
12.7	8.3	5.2	Holotype (MZUSP 26691)
11.2	7.7	4.7	Paratype (MZUSP 26699)

Single valves

		hemidiameter	
21.6	15.3	5.0 (right valve)	Paratype (MZUSP 26700)

16.1	10.7	3.4 (left valve)	Paratype (MZUSP 26701)
14.2	9.0	2.9 (right valve)	Paratype (MZUSP 26702)
12.2	8.1	2.8 (left valve)	Paratype (MZUSP 26703)
10.7	7.3	2.3 (right valve)	Paratype (MZUSP 26704)
7.8	5.5	1.8 (left valve)	Paratype (MZUSP 26705)

Remarks: This species is placed in the genus *Calyptogena* Dall, 1891 (type-species, by monotypy, *Calyptogena pacifica* Dall, 1891: 190), based on the original description of the genus, the figures given by Boss (1968: 740-741, figs. 16-17, 19-20) and Keen (1969: N663, fig. E138-11a,b), and the redescription given by Boss & Turner (1980: 162-164). The presence of an escutcheon and the close resemblance of its hinge plate elements to that of *C. pacifica* allow the inclusion of this species in the subgenus *Calyptogena* s.s. as established by Keen (1969), followed and modified by Boss & Turner (1980: fig. 10).

Callocardia [= *Vesicomya*] *albida* Dall, 1889: 268, from ALBATROSS station 2762, Rio de Janeiro coast, Brazil, at a depth of 108 m, was the first member of the Vesicomyiidae



FIG. 5–7. The dentition of the left valve of *Calyptogena birmani*: 5, holotype (length = 12.7 mm, area shown = 7.6 mm); 6–7, paratypes (DZ-IBUSP, single valves without registration number) (6, length = 12.5 mm, area shown = 7.5 mm; 7, length = 11.7 mm, area shown = 7.1 mm). Note differences in dental elements.

reported from the southwest Atlantic. It is easily distinguished from *Calyptogena birmani* by its rounded, inflated shell (Dall's measurements from a single left valve, the only specimen known to date: "altitude of shell 8; longitude 9; diameter 7 mm").

Fourteen living species are currently referable to *Calyptogena*, three of which are from the Atlantic (Boss & Turner, 1980; Okutani & Métivier, 1986; Métivier, Okutani & Ohta, 1986; Stuardo & Valdovinos, 1988). The Atlantic species most closely related to *C. birmani* is *C. (C.) valdiviae* (Thiele & Jaeckel, 1931: 229, pl. 9 (4), fig. 101), from VALDIVIA station 33 (24°35.3'N; 17°4.7'W), about 225 km off Morro Garnet, Rio de Oro, West Africa, at a depth of 2,500 m, and station 103 (35°10.5'S; 23°2'E), about 116 km south of Knysna, Republic of South Africa, at a depth of 500 m. *Calyptogena birmani* is distinguished from *C. valdiviae* by being much smaller, less inflated, having a pointed, angular posterior margin, giving a veneroid outline to most specimens. The anterodorsal margin

in *C. birmani* is convex; that in *C. valdiviae* is slightly concave, as can be seen in Boss' (1970) figures 3 and 4, selected by him as lectotype for *C. valdiviae*, though he described it as convex. In addition, the posterior ramus of the subumbonal cardinal tooth of the left valve is stronger and more elevated than that of *C. valdiviae*.

Calyptogena (C.) ponderosa Boss, 1968: 737–742, figs. 9, 11–15, 18, type-locality M/V Oregon I station 1426 (29°7'N; 87°54'W), about 124 km south of Mobile Bay, Gulf of Mexico, at a depth of 1,097 m, is similar to *C. birmani* in outline, configuration of the pallial sinus, and internal russet stain, but greatly differs in its much larger size, heavier and thicker shell, more anteriorly placed umbos, rounded adductor muscle scars and distinctly cardinal dentition of both valves.

Calyptogena (Ectenagena) modioliforma (Boss, 1968: 742–746, figs. 10, 21–24, 26–27), type-locality R/V Pillsbury station 394 (9°28.6'N; 76°26.3'W), Golf del Darien, 106 km NNE of Punta Caribana, Colombia, at the



FIG. 8–10. The dentition of the right valve of *Calyptogena birmani*: 8, holotype (length = 12.7 mm, area shown = 7.6 mm); 9–10, paratypes (DZ-IBUSP, single valves without registration number) (9, length = 13.2 mm, area shown = 7.8 mm; 10, length = 11.3 mm, area shown = 7.9 mm). Note differences in dental elements. Figures 9–10 are not from the same specimens shown in Figures 6–7.

depth of 421–641 m, is the third *Calyptogena* previously known from Atlantic waters. The frangible, nearly modioliform shell and larger size of this species readily separate it from *C. birmani*. More importantly, the presence of a large ligament, lack of an escutcheon and of an anterodorsal cardinal element, traits used by Boss & Turner (1980) to define its subgeneric position in *Ectenagena* Woodring, 1938: 51 (type-species, by original designation, *Calyptogena elongata* Dall, 1916: 408), are striking features separating *C. modioliforma* from *C. birmani*.

The Pacific *Calyptogena* species most closely related to *C. birmani* are *C. pacifica* and *C. (Archivesica) kilmeri* Bernard, 1974: 17–18, text-figs. 1B, 2B, 3B, 4B and 4E, type-locality FRB station 67–50 (53°1'N; 132°56'W) off west coast of Moresby Island, Queen Charlotte Islands, British Columbia, Canada, in 1,170 m.

Calyptogena birmani differs from *C. pacifica* and *C. kilmeri* in its smaller size (less than

a half of the shell length attained by *C. pacifica* and *C. kilmeri*), longer ligament (2/3 of the escutcheon length in *C. birmani*, approximately 1/2 in *C. pacifica* and about 1/3 in *C. kilmeri*), more convex ventral margin and more angular posterior margin. *Calyptogena birmani* also differs from *C. pacifica* by the presence of a distinct pallial sinus and by the hinge traits of its right valve: it has a shorter anterior extension of the dorsal cardinal tooth and absence of any trace of posterior cardinal tooth. The presence of a distinct pallial sinus and absence of any trace of posterior cardinal tooth are traits shared by *C. birmani* and *C. kilmeri*.

As noted in Boss (1968) and Boss & Turner (1980), there is in *Calyptogena* a great intraspecific variation in outline and all dental elements. Figures 5–14 of *Calyptogena birmani* confirm those authors' observations.

Considering the size attained (200 mm or more in length) by specimens of the species of *Calyptogena*, the examined shells of *C. bir-*

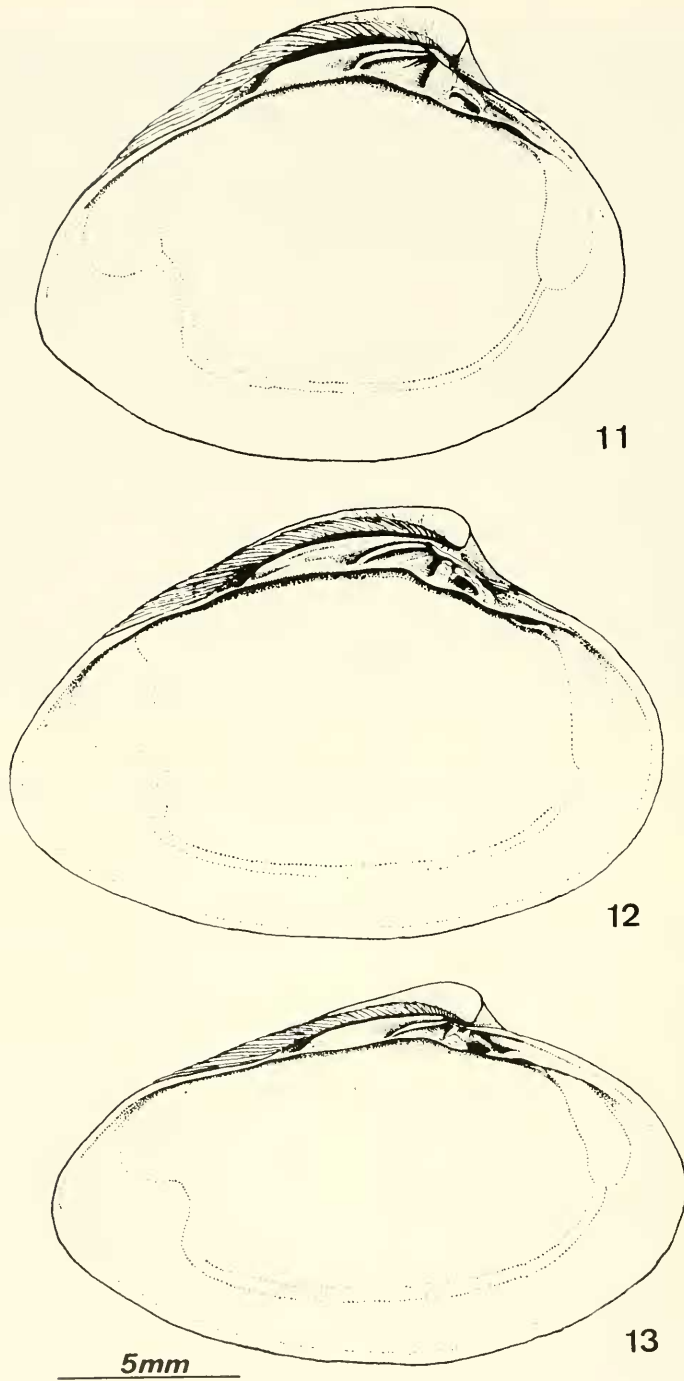


FIG. 11–13. Camera lucida drawing of left valves showing shell outlines, hinge and muscle scars of *Calypptogena birmani*. 11, a conspicuous subtrigonal, veneroid-type; 12, an intermediate form between 11 and 13; 13, a characteristic oval-elongate type. Note variations in the hinge height, subumbonal cardinal tooth and convexity of the posterior dorsal margin. 11, paratype MZUSP 26696; 12 and 13, paratypes DZ-IBUSP, without registration number.

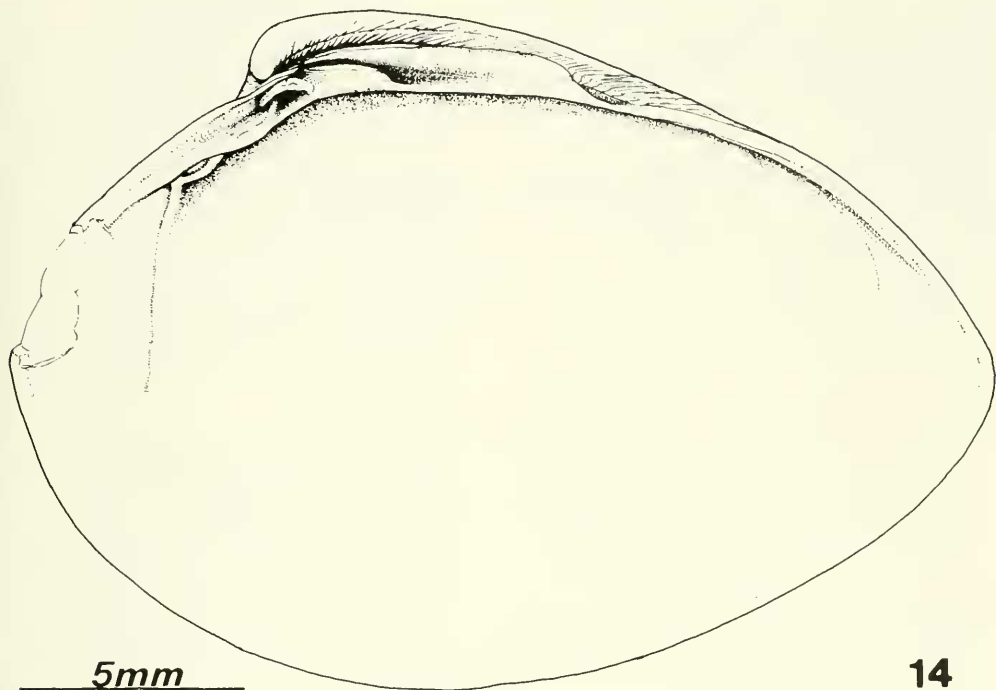


FIG. 14. Camera lucida drawing of the largest specimen of *Calyptogena birmani* (paratype MZUSP 26700). Internal view of the single right valve showing details of the hinge plate and well-impressed anterior muscle scars (adductor and pedal retractor). Valve damaged at the anterior slope; pallial and posterior adductor muscle scars partially vanished by erosion.

mani, ranging from 7.8 to 21.6 mm in length, may represent a collection of young of a much larger species. Further collecting in the area where these specimens come from may produce additional material to confirm this premise.

Etymology: This species is named for Adolpho Birman, a physician interested in molluscan studies and collections, who generously donated the specimens analysed in this paper.

Observations: The holotype is the best preserved specimen among all complete ones. Nevertheless, the right valve has the shelf-like anterior extension of the dorsal cardinal tooth slightly broken and the left valve was unfortunately broken during handling for photos, but it was reconstructed later.

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